Extra Info
03-12-07

Roland Bartl

From: Roland Bartl
Sent: Wednesday, March 07, 2007 12:19 PM
To: John Murray
Cc: Bruce Stamski
Subject: Route 27 (Main Street) Corridor Study

John:

Study covers Main Street corridor from Route to Brook Street.

Date of final report: August 1, 2001

View report: http://doc.acton-ma.gov/dsweb/View/Collection-850/Document-15823

Public Outreach summary on page 4. Details:

2 public meetings/workshops in the library at the beginning of the project on 9/13/2000 (16 persons attended) and 9/14/2000 (24 persons attended) for project intro and initial public input.

2 public meetings/workshops in the library on 12/7/2000 (16 persons attended) and 12/12/2000 (15 persons attended) for discussion, vetting, and assistance in the selection of study recommendations.

All meetings/workshops were advertised in the Beacon newspaper, and direct invitations for all meetings were mailed to 150 addresses along and adjacent to corridor.

I believe the final report was presented to the Board of Selectmen sometime in 2001 or early 2002.

Please let me know if you need additional information.

Regards -

Roland Bartl, AICP
Town Planner, Town of Acton
472 Main Street
Acton, MA 01720
978-264-9636

cc: BOS 2/4/97 (2)

Main Street - Hayward Road Signal Design Study

Public Information Meeting

The Board of Selectmen will meet to discuss the proposed improvements to the Main Street / Hayward Road Intersection, including signals, a left turn lane on Main Street and geometric changes.

Tuesday, February 4, 1997
8:00 - 8:15 PM
Acton Town Hall - Room 204
472 Main Street

Handicapped Accessible. All are welcome

For more information, call David F. Abbt , Engineering Administrator, at 264-9628.

Table 8
Route 27 Corridor - Traffic Signal Warrant

Warrant	Description	Route 27 at Hayward Road	Route 27 at Newtown Road
Warrant #1 Minimum Vehicular Volume	Satisfied when the volume of intersecting traffic (Major and minor streets) exceeds the MUTCD threshold for 8 or more hours	Criteria Satisfied	Criteria Not Satisfied
Warrant #2 Interruption of Continuous Traffic	Satisfied when the volume of major street traffic is so heavy that minor street traffic suffers excessive delay in entering or crossing the major street for more than 8 hours	Criteria Satisfied	Criteria Satisfied
Warrant #3	Satisfied when pedestrian volume crossing the major street at an intersection or mid block location is an average of 100 or more for each of any 4 hours or 190 or more during any one-hour.	Criteria Not Satisfied	Criteria Not Satisfied
Warrant #6 Accident Experience	Satisfied when 5 or more accidents that are of the type that can be reduced through the installation of a traffic signal occur in one year as well as volumes in excess of 80 percent of the threshold volumes of Warrants 1 and 2	Criteria Satisfied	Criteria Satisfied
Warrant # 8 Combination of Warrants	Satisfied when volumes (major and minor) exceed 80 percent of the threshold volumes of Warrants 1 and 2 for more than 8 hours	Criteria Satisfied	Criteria Not Satisfied
Warrant #9	Satisfied when each of any four hours of an average day fall above the curve in Figure 4-7 (see Appendix).	Criteria Satisfied	Criteria Satisfied
Warrant #11	Satisfied when one hour of the day falls above the curve in Figure 4-5 (see Appendix). Traffic conditions are such that the minor street traffic suffers undue traffic delay in entering or crossing the major street.	Criteria Satisfied	Criteria Satisfied

In addition to the above key locations, peak hour warrants 9 and 11 were investigated at Roue 27 at the Route 2 ramps, Route 27 at Nagog Hill Road, and Route 27 and Brook Street. Peak hour warrants were not met at Route 27 at Nagog Hill Road, Brook Street or the Route 2 westbound ramps. Therefore it is highly unlikely that the daily warrants would be met at these intersections. However, it is expected that the Route 2 westbound ramps will meet peak hour signal warrants under future traffic conditions. Peak hour warrants 9 and 11 were met for Route 27 at the Route 2 eastbound ramps.

Vanasse Hangen Brustlin, Inc.

Transportation
Land Development
Environmental Services

VHB

101 Walnut Street
Post Office Box 9151
Watertown
Massachusetts 02272
617 924 1770
FAX 617 924 2286

Memorandum

To: Mr. David Abbt
Engineering Administrator
Town Hall
472 Main Street
Acton, MA 01720

Date: June 20, 1996

Project No.: 04994.12

From: John J. Kennedy, P.E.

Re: Hayward Road, Main Street
Signal Warrant Study

Vanasse Hangen Brustlin has completed a review of traffic operations in the vicinity of the Hayward Road, Main Street intersection as part of a traffic signal warrant study. This Memo has been prepared to report findings and define needed intersection improvements associated with signal installation should signals be found to be warranted and desirable.

Traffic counts were conducted at the intersection for a twelve hour period on June 5, 1996. In addition, a speed study was conducted along the Main Street corridor north of the intersection during mid-afternoon on June 5, and accident reports furnished by the Town covering the period from January, 1993 through May 21, 1996 were analyzed.

Analysis of the traffic count data suggests that traffic signal control is warranted based on criteria defined in the Manual on Uniform Traffic Control Devices (MUTCD). Volumes exceeded thresholds requires for Warrants 1 and 2, Minimum Vehicular Volumes and Interruption of Continuous Traffic respectively, for more than eight hours. These are considered the two primary warrants of the eleven available for review in the MUTCD. Traffic volumes exceeded a total of 750 vehicles per hour on Main Street (total both directions) for the entire twelve hour count period. Volumes on Hayward Road totaled 150 vehicles of more for 11 of the 12 hours. To satisfy Warrant 1 requirements, Main Street flow must exceed 500 vehicles per hour for a minimum of eight hours on an average day with side street demand totaling 150 or more vehicles during the same eight hours. Under Warrant 2 Main Street volumes must equal or exceed 750 vehicles per hour for eight hours with the side street approach carrying 75 or more vehicles during the same eight hours. Given accident incidence within the area, the aforementioned volumes may be reduced by 20%.

A summary of the warranting conditions is provided in Table 1. Turning movement count field sheets are also attached.

Accident data for the intersection shows a total of 14 accidents between January, 1993 and May, 1996. The predominant accident type is rear end (all northbound) with five cross movement/angle

collisions reported. All angle type involved southbound movement on Main Street and eastbound left turns from Hayward Road. One fixed object (citation issued for D.W.I.) and one pedestrian accident were also reported. A collision Diagram is attached.

Median speeds in the corridor north of the intersection (between Coughlin St. and Taylor Rd.) were generally 36 to 38 miles per hour northbound and 34 to 36 miles per hour southbound. The 85th percentile speed, i.e. the speed at which the 85th fastest car out of 100 observations was traveling, was 40 to 42 miles per hour northbound and 36 to 38 miles per hour southbound. Speed measurement was conducted during free flow traffic conditions during the mid afternoon period and involved 100 observations each of northbound and southbound movement. Note that these speeds are near the threshold value of 40 miles per hour allowing for a reduction in warranting volumes to 70 percent of the above stated Warrant 1 and 2 values.

Generally the installation of traffic signals in a two lane corridor such as Main Street reduce the carrying capacity of the intersection and should be accompanied with geometric improvements in the corridor. This intersection appears to follow that trend. An initial critical lane volume analysis and review of left turn conditions suggests that if a signal is installed, an advance left turn phase for northbound Main Street should be provided followed by general north and south movement in the Main Street corridor. This would be followed by movement from Hayward Road. To minimize the impact of the left turning vehicles on northbound Main Street flow after the end of the advance phase, to insure that the advance phase may be fully utilized, and to minimize the impact on southbound Main Street flow, a left turn lane should be provided on Main Street northbound.

Given the 50 foot wide right-of-way which exists in the corridor, it appears that the widening necessary to create the left turn lane may be accomplished without strip property taking in the Main Street corridor. Both sides of the existing 23 to 26 foot wide roadway should be widened to a total width of 38 feet allowing a 150 foot long northbound left lane 11 feet in width and a northbound through lane of 13 feet in width. A 14 foot southbound departure should be provided. North of the intersection, the roadway curvature will allow an easy transition from the two lane northbound approach to a single lane departure. On the north side of the intersection, a widening on the westerly side of the corridor will also be required to allow retention of the two lane (through and right) approach. One taking is recommended however. The corner radius should be substantially increased on the southwest side of the intersection to allow truck movement through the area. This improved corner radius becomes critical with signal installation as trucks turning will now be subjected to the presence of stopped left turning vehicles which will not be permitted to proceed through the intersection to allow trucks the full width of Main Street to complete a right turn.

We have estimated construction costs associated with signal installation to be between $150,000 and $200,000 given the needed widening associated with the signals. (signals alone are estimated at $80,000.) This is exclusive of land taking.

TABLE 1

Signal Warrant Review

Site: Main Street (Route 27) @ Hayward Road, Acton, Mass

Roadway Conditions: Main Street - 1 lane per direction

Hayward Road - 1 approach lane

Intersection Type: "Tee"

85th Percentile Speed: ± 38 mph

Warranting Volumes w/o reduction factors

Warrant 1 "Minimum Vehicular Volumes"

Main Street 500 vph for 8 hours - total both directions

Hayward Road 150 vph for same 8 hours

Warrant 2 " Interruption of Continuous Traffic

Main Street - 750 vph for 8 hours (total in both directions)

Hayward Road - 75 vph for same 8 hours

	Main Street			Hayward Road	Warrant	
Hour	NB	SB	Total	EB	1	2
7 - 8	686	537	1,223	248	Yes	Yes
8 - 9	722	640	1,362	222	Yes	Yes
9 - 10	638	555	1,194	211	Yes	Yes
10 - 11	632	544	1,176	170	Yes	Yes
11 - 12	627	668	1,293	177	Yes	Yes
12 - 1	678	671	1,349	150	Yes	Yes
1 - 2	568	641	1,209	131	No	Yes
2 - 3	641	692	1,333	263	Yes	Yes
3 - 4	724	826	1,550	280	Yes	Yes
4 - 5	743	880	1,623	254	Yes	Yes
5 - 6	794	1,013	1,807	256	Yes	Yes
6 - 7	747	745	1,492	260	Yes	Yes
				Total Hours	11	12

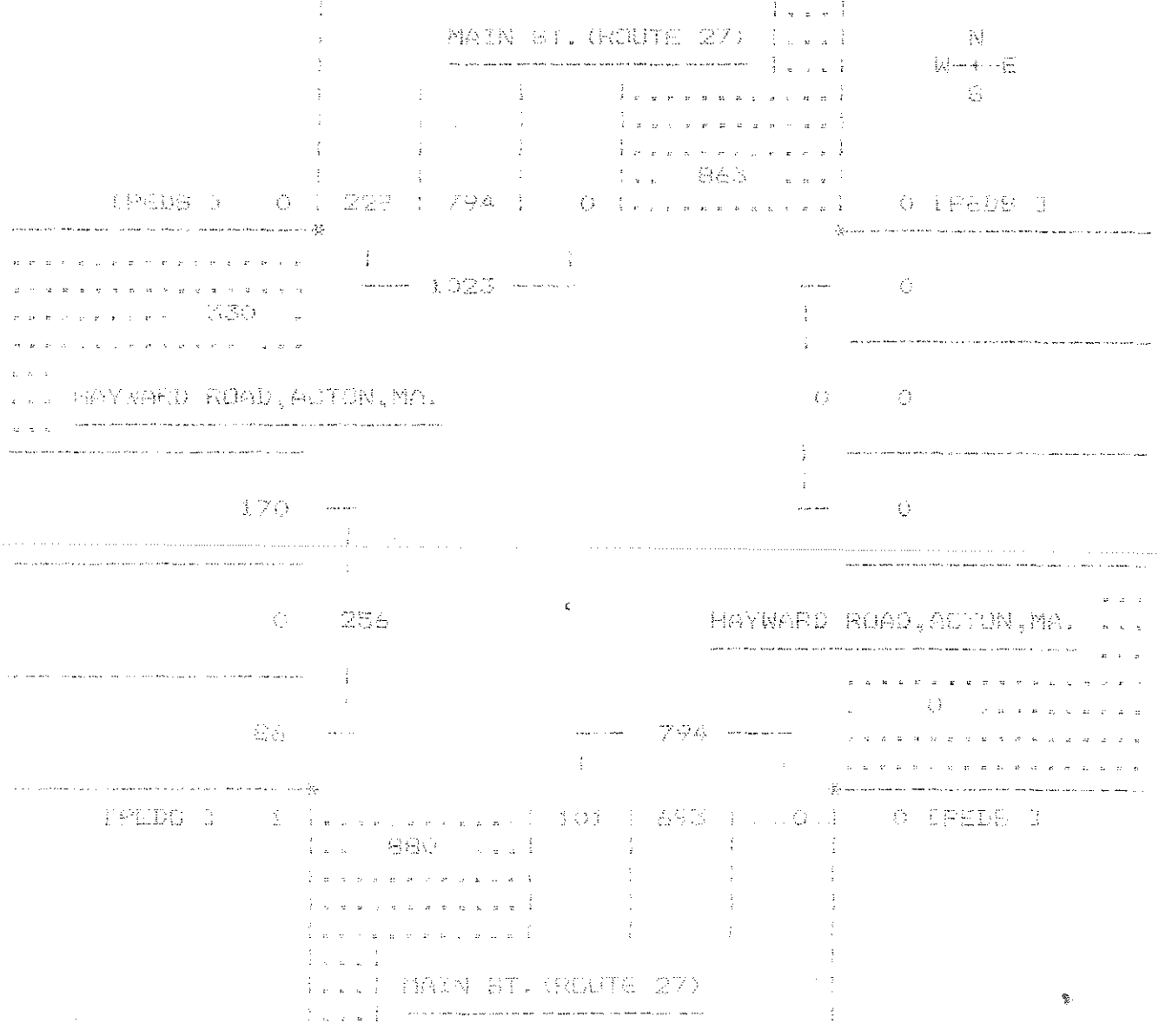
Signals are warranted under Nos. 1 & 2 without application of accident reduction factor associated with Warrant 6.

PEAK PERIOD ANALYSIS FOR THE PERIOD: 7:00 AM - 7:00 PM

DIRECTION APPR	START PEAK HOUR	PEAK HR FACTOR	VOLUMES					PERCENTS			
			RIGHT	THRU	LEFT	U-RT	TOTAL	RIGHT	THRU	LEFT	
North	12:00 PM	0.84	0	229	794	0	1023	-	22	78	0
East	5:45 PM	0.81	0	0	0	0	0	-	0	#DIV/0!	0
South	12:45 PM	0.91	0	0	703	106	809	-	0	87	13
West	12:15 PM	0.93	0	94	0	192	286	-	33	0	67

Entire Intersection

North	5:00 PM	.84	0	229	794	0	1023	-	22	78	0
East		0.80	0	0	0	0	0	-	0	0	0
South		0.96	0	0	693	101	794	-	0	87	13
West		0.90	1	86	0	170	256	-	34	0	66



Site Code : ACTON
N-S Street: MAIN ST.(ROUTE 27)
E-W Street: HAYWARD ROAD,ACTON,MA.
Weather : PT.CLOUDY,WARM

Sum of the Primary and Secondary

FILE: ACTON7-7

DATE: 6/05/96

Time Begin	(1) From North PEDS	RT	THRU	LT	From East PEDS	RT	THRU	LT	(9) From South PEDS	RT	THRU	LT	(13) From West PEDS	RT	THRU	LT	Vehicle Total	PEDS Total
7:00 AM	0	29	76	0	0	0	0	0	0	0	102	15	0	12	0	28	262	0
7:15	0	66	122	0	0	0	0	0	0	0	125	30	1	34	0	57	435	1
7:30	0	14	94	0	0	0	0	0	0	0	189	10	1	22	0	43	382	1
7:45	0	25	101	0	0	0	0	0	0	0	200	14	0	14	0	38	392	0
HR TOTAL	0	144	393	0	0	0	0	0	0	0	617	69	2	82	0	166	1471	2
8:00 AM	0	42	99	0	0	0	0	0	0	0	157	20	0	22	0	54	394	0
8:15	0	31	124	0	0	0	0	0	0	0	172	9	0	15	0	50	401	0
8:30	0	29	139	0	0	0	0	0	1	0	164	14	0	17	1	35	399	1
8:45	0	50	126	0	0	0	0	0	0	0	169	17	0	14	0	15	391	0
HR TOTAL	0	152	488	0	0	0	0	0	1	0	662	60	0	68	1	154	1585	1
9:00 AM	0	38	116	0	0	0	0	0	0	0	159	23	0	19	0	43	399	0
9:15	0	21	135	0	0	0	0	0	0	0	133	16	0	16	0	29	350	0
9:30	0	18	106	0	0	1	0	0	0	0	136	9	0	15	0	29	314	0
9:45	0	16	106	0	0	0	0	0	0	0	156	7	0	20	0	40	347	0
HR TOTAL	0	93	463	0	0	1	0	0	0	0	584	55	0	70	0	141	1406	0
10:00 AM	0	27	132	0	0	0	0	0	0	0	127	10	0	19	0	23	328	0
10:15	0	16	108	0	0	0	0	0	0	0	156	13	0	10	0	33	336	0
10:30	0	22	92	0	0	0	0	0	0	0	141	15	0	15	0	32	320	0
10:45	0	25	129	0	0	0	0	0	0	0	158	12	0	14	0	24	362	0
HR TOTAL	0	90	454	0	0	0	0	0	0	0	582	50	0	58	0	112	1346	0
11:00 AM	0	19	138	0	0	0	0	0	1	0	134	10	0	15	0	27	343	1
11:15	0	19	129	0	0	0	0	0	0	0	131	10	0	17	0	23	329	0
11:30	0	30	143	0	0	0	0	0	0	0	153	13	1	25	0	32	396	1
11:45	0	28	162	0	0	0	0	0	0	0	154	22	0	19	0	19	404	0
HR TOTAL	0	96	572	0	0	0	0	0	1	0	572	55	1	76	0	101	1472	2
12:00 PM	0	30	135	0	0	0	0	0	0	0	165	10	0	19	0	20	379	0
12:15	0	36	157	0	0	0	0	0	0	0	129	16	0	15	0	23	376	0
12:30	0	29	137	0	0	0	0	0	0	0	176	16	0	14	0	26	398	0
12:45	0	20	128	0	0	0	0	0	0	0	154	12	0	11	0	22	347	0
HR TOTAL	0	115	557	0	0	0	0	0	0	0	624	54	0	59	0	91	1500	0
1:00 PM	0	27	135	0	0	0	0	0	0	0	128	10	0	4	0	14	318	0
1:15	0	29	129	0	0	0	0	0	0	0	129	4	0	13	0	27	331	0
1:30	0	21	136	0	0	0	0	0	0	0	117	14	0	16	0	21	325	0
1:45	0	38	126	0	0	0	0	0	0	0	141	25	0	14	0	22	366	0
HR TOTAL	0	115	526	0	0	0	0	0	0	0	515	53	0	47	0	84	1340	0
2:00 PM	0	38	144	0	0	0	0	0	0	0	135	19	0	26	0	34	396	0
2:15	0	24	150	0	0	0	0	0	0	0	123	23	0	22	0	59	401	0
2:30	0	29	137	0	0	0	0	0	0	0	156	13	1	25	0	36	398	1
2:45	0	34	136	0	0	0	0	0	0	0	156	14	2	18	0	43	401	2
HR TOTAL	0	125	567	0	0	0	0	0	0	0	572	69	3	91	0	172	1596	3

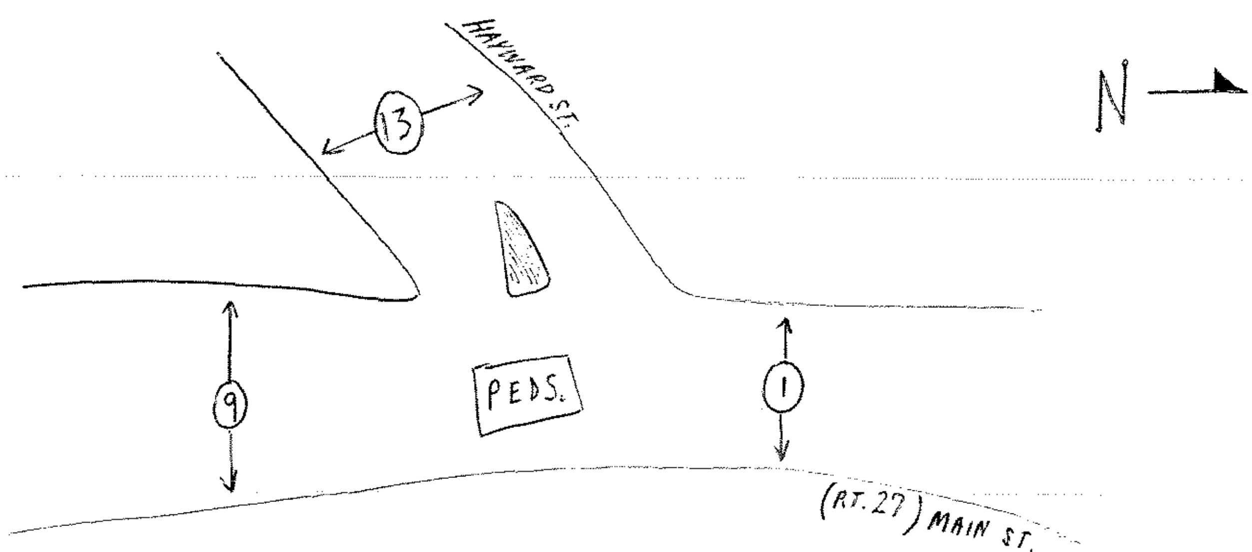
Site Code : ACTON
N-S Street: MAIN ST. (ROUTE 27)
E-W Street: HAYWARD ROAD, ACTON, MA.
Weather : [illegible], CLOUDY, WARM

Sum of the Primary and Secondary

FILE: ACTON[illegible]

DATE: [illegible]

Time Begin	(1) PEDS	From North RT	From North THRU	From North LT	From East PEDS	From East RT	From East THRU	From East LT	(9) From South PEDS	From South RT	From South THRU	From South LT	(13) From West PEDS	From West RT	From West THRU	From West LT	Vehicle Total	PEDS Total
3:00 PM	0	38	153	0	0	0	0	0	0	0	157	10	0	19	0	51	431	0
3:15	0	49	161	0	0	0	0	0	0	0	146	28	0	25	0	37	447	0
3:30	0	36	137	0	0	0	0	0	0	0	169	27	0	33	0	54	456	0
3:45	0	23	176	0	0	0	0	0	0	0	167	27	0	23	0	48	466	0
HR TOTAL	0	146	627	0	0	0	0	0	0	0	639	95	0	90	0	190	1840	0
4:00 PM	0	40	164	0	0	0	0	0	0	0	197	23	0	22	0	53	500	0
4:15	0	29	189	0	0	0	0	0	0	0	142	12	0	17	0	37	426	0
4:30	0	45	173	0	0	0	0	0	0	0	155	17	0	17	0	40	447	0
4:45	0	46	194	0	0	0	0	0	0	0	175	22	0	28	0	35	504	0
HR TOTAL	0	160	720	0	0	0	0	0	0	0	669	74	0	84	0	165	1877	0
5:00 PM	0	58	248	0	0	0	0	0	0	0	195	22	0	24	0	47	594	0
5:15	0	44	199	0	0	0	0	0	0	0	166	23	0	24	0	39	495	0
5:30	0	44	171	0	0	0	0	0	0	0	177	22	1	24	0	42	480	1
5:45	0	53	178	0	0	0	0	0	0	0	165	24	0	14	0	42	519	0
HR TOTAL	0	229	796	0	0	0	0	0	0	0	693	101	1	86	0	170	2073	1
6:00 PM	0	44	163	0	0	0	0	0	0	0	167	27	1	26	0	26	453	1
6:15	0	33	143	0	0	0	0	0	0	0	186	21	1	63	0	39	485	1
6:30	0	32	169	0	0	0	3	0	0	0	185	23	0	37	0	28	473	0
6:45	0	23	138	0	0	0	0	0	0	0	124	13	0	18	0	23	339	0
HR TOTAL	0	132	613	0	0	0	3	0	0	0	663	84	2	144	0	116	1755	2
DAY TOTAL	0	1596	6627	0	0	1	3	0	2	0	7392	819	12	956	1	1666	19261	14



PEAK PERIOD ANALYSIS FOR THE PERIOD: 7:00 AM - 7:00 PM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES PEDS	Right	Thru	Left	Total	PERCENTS PEDS	Right	Thru	Left
North	5:00 PM	0.84	0	229	794	0	1023	-	22	78	0
East	5:45 PM	0.25	0	0	3	0	3	-	0	%100	0
South	3:45 PM	0.97	0	0	704	105	809	-	0	87	13
West	3:15 PM	0.93	0	94	0	192	286	-	33	0	67

Entire Intersection

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES PEDS	Right	Thru	Left	Total	PERCENTS PEDS	Right	Thru	Left
North	5:00 PM	0.84	0	229	794	0	1023	-	22	78	0
East		0.00	0	0	0	0	0	-	0	0	0
South		0.96	0	0	693	101	794	-	0	87	13
West		0.90	1	86	0	170	256	-	34	0	66

Site Code : ACTON
N-S Street: MAIN ST.(ROUTE 27)
E-W Street: HAYWARD ROAD,ACTON,MA.
Weather : PT.CLOUDY,WARM

Movements by: Primary

FILE: ACTON97-7
DATE: 6/05/96

Time Begin	From North PEDS	From North RT	From North THRU	From North LT	From East PEDS	From East RT	From East THRU	From East LT	From South PEDS	From South RT	From South THRU	From South LT	From West PEDS	From West RT	From West THRU	From West LT	Vehicle Total	PEDS Total
7:00 AM	0	29	75	0	0	0	0	0	0	0	102	15	0	12	0	28	261	0
7:15	0	66	120	0	0	0	0	0	0	0	124	30	1	34	0	57	431	1
7:30	0	24	95	0	0	0	0	0	0	0	188	10	1	22	0	42	379	1
7:45	0	25	100	0	0	0	0	0	0	0	196	13	0	14	0	38	386	0
HR TOTAL	0	144	390	0	0	0	0	0	0	0	610	68	2	82	0	165	1457	
8:00 AM	0	42	97	0	0	0	0	0	0	0	153	19	0	22	0	54	387	0
8:15	0	31	121	0	0	0	0	0	0	0	169	9	0	15	0	50	395	0
8:30	0	29	135	0	0	0	0	0	1	0	159	13	0	17	1	35	389	1
8:45	0	49	123	0	0	0	0	0	0	0	165	17	0	13	0	15	382	0
HR TOTAL	0	151	476	0	0	0	0	0	1	0	646	58	0	67	1	154	1553	
9:00 AM	0	35	114	0	0	0	0	0	0	0	156	23	3	19	0	43	390	3
9:15	0	21	133	0	0	0	0	0	0	0	131	14	0	16	0	27	342	0
9:30	0	18	102	0	0	1	0	0	0	0	133	7	0	14	0	29	304	0
9:45	0	18	103	0	0	0	0	0	0	0	154	6	0	18	0	40	339	0
HR TOTAL	0	92	452	0	0	1	0	0	0	0	574	50	3	67	0	139	1375	
10:00 AM	0	26	118	0	0	0	0	0	0	0	126	10	0	19	0	23	322	0
10:15	0	16	106	0	0	0	0	0	0	0	154	13	0	10	0	33	332	0
10:30	0	21	92	0	0	0	0	0	0	0	135	13	0	14	0	32	307	0
10:45	0	25	126	0	0	0	0	0	0	0	152	11	0	12	0	23	349	0
HR TOTAL	0	88	442	0	0	0	0	0	0	0	567	47	0	55	0	111	1310	
11:00 AM	0	19	133	0	0	0	0	0	1	0	134	9	0	13	0	27	335	1
11:15	0	19	128	0	0	0	0	0	0	0	128	9	0	16	0	23	323	0
11:30	0	30	141	0	0	0	0	0	0	0	152	13	1	24	0	32	392	1
11:45	0	28	160	0	0	0	0	0	0	0	150	20	0	17	0	19	394	0
HR TOTAL	0	96	562	0	0	0	0	0	1	0	564	51	1	70	0	101	1444	
12:00 PM	0	30	120	0	0	0	0	0	0	0	162	10	0	19	0	20	371	0
12:15	0	26	139	0	0	0	0	0	0	0	127	13	0	15	0	23	365	0
12:30	0	29	133	0	0	0	0	0	0	0	175	15	0	14	0	25	391	0
12:45	0	20	127	0	0	0	0	0	0	0	151	11	0	8	0	22	339	0
HR TOTAL	0	115	539	0	0	0	0	0	0	0	615	51	0	56	0	90	1466	
1:00 PM	0	17	133	0	0	0	0	0	0	0	125	10	0	4	0	14	313	0
1:15	0	29	128	0	0	0	0	0	0	0	126	4	0	13	0	17	327	0
1:30	0	21	134	0	0	0	0	0	0	0	112	11	0	10	0	20	[illegible]	0
1:45	0	37	124	0	0	0	0	0	0	0	[illegible]	[illegible]	0	13	0	22	[illegible]	[illegible]
HR TOTAL	0	114	519	0	0	0	0	0	0	0	494	49	0	[illegible]	0	[illegible]	[illegible]	
2:00 PM	0	38	135	0	[illegible]	[illegible]	0	0	0	0	[illegible]	[illegible]	0	[illegible]	0	34	383	0
2:15	[illegible]	28	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	0	52	0	59	392	0
2:30	[illegible]	23	[illegible]	0	[illegible]	[illegible]	[illegible]	0	[illegible]	0	135	13	1	20	0	34	396	1
2:45	0	24	[illegible]	0	0	0	0	0	0	0	155	10	2	15	0	43	395	2
HR TOTAL	0	[illegible]	[illegible]	0	0	0	0	0	0	0	566	55	3	67	0	172	[illegible]	

Time	.... From North				.... From East				.... From South				.... From West				Vehicle	PEDS
Begin	PEDS	RT	THRU	LT	PEDS	RT	THRU	LT	PEDS	RT	THRU	LT	PEDS	RT	THRU	LT	Total	Tota
3:00 PM	0	38	149	0	0	0	0	0	0	0	154	12	0	19	0	51	423	0
3:15	0	47	150	0	0	0	0	0	0	0	143	26	0	24	0	37	435	0
3:30	0	35	182	0	0	0	0	0	0	0	166	23	0	27	0	53	486	0
3:45	0	13	178	0	0	0	0	0	0	0	165	26	0	20	0	45	460	0
HR TOTAL	0	142	667	0	0	0	0	0	0	0	630	89	0	88	0	189	1804	[illegible]
4:00 PM	0	40	182	0	0	0	0	0	0	0	193	22	0	21	0	53	491	0
4:15	0	20	187	1	0	0	0	0	0	0	142	12	1	16	0	36	421	0
4:30	0	45	165	0	0	0	0	0	0	0	153	15	0	17	0	40	439	0
4:45	0	46	192	0	0	0	0	0	0	0	174	22	0	27	0	39	500	0
HR TOTAL	0	159	710	0	0	0	0	0	0	0	662	71	0	81	0	168	1851	[illegible]
5:00 PM	0	58	247	0	0	0	0	0	0	0	184	21	0	23	0	46	579	0
5:15	0	44	198	0	0	0	0	0	0	0	165	23	0	24	0	39	493	0
5:30	0	44	170	0	0	0	0	0	0	0	177	22	1	23	0	42	478	1
5:45	0	83	175	0	0	0	0	0	0	0	165	33	0	14	0	42	512	0
HR TOTAL	0	225	790	0	0	0	0	0	0	0	691	99	1	84	0	169	2062	1
6:00 PM	0	44	163	0	0	0	0	0	0	0	167	26	1	26	0	26	452	1
6:15	0	33	143	0	0	0	0	0	0	0	166	21	1	63	0	38	464	1
6:30	0	32	169	0	0	0	3	0	0	0	186	23	0	37	0	28	475	0
6:45	0	33	138	0	0	0	0	0	0	0	124	10	0	15	0	22	338	0
HR TOTAL	0	131	613	0	0	0	3	0	0	0	663	83	2	144	0	114	1752	2
DAY TOTAL	0	1538	6709	0	0	1	3	0	2	0	7282	781	12	924	1	1635	18944	14

PEAK PERIOD ANALYSIS FOR THE PERIOD: 7:00 PM - 7:00 PM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES PEDS	VOLUMES Right	VOLUMES Thru	VOLUMES Left	VOLUMES Total	PERCENTS PEDS	PERCENTS Right	PERCENTS Thru	PERCENTS Left
North	5:00 PM	0.84	0	229	790	0	1019	-	22	78	0
East	5:45 PM	0.25	0	0	3	0	3	-	0	100	0
South	5:45 PM	0.97	0	0	704	103	807	-	0	87	13
West	7:15 AM	0.78	2	92	0	191	283	-	33	0	67

Entire Intersection

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES PEDS	VOLUMES Right	VOLUMES Thru	VOLUMES Left	VOLUMES Total	PERCENTS PEDS	PERCENTS Right	PERCENTS Thru	PERCENTS Left
North	5:00 PM	0.84	0	229	790	0	1019	-	22	78	0
East		0.00	0	0	0	0	0	-	0	0	0
South		0.96	0	0	691	99	790	-	0	87	13
West		0.92	1	84	0	169	253	-	33	0	67

Site Code : ACTON
N-S Street: MAIN ST.(ROUTE 27)
E-W Street: HAYWARD ROAD,ACTON,MA.
Weather : PT.CLOUDY,WARM

Movements by: Secondary

FILE: ACTON7-?
DATE: 6/25/96

Time	.... From North				.... From East				.... From South				.... From West				Vehicle	PEDS
Begin	PEDS	RT	THRU	LT	PEDS	RT	THRU	LT	PEDS	RT	THRU	LT	PEDS	RT	THRU	LT	Total	Total
7:00 AM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
7:15	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	4	0
7:30	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	3	0
7:45	0	0	1	0	0	0	0	0	0	0	4	1	0	0	0	0	6	0
HR TOTAL	0	0	5	0	0	0	0	0	0	0	7	1	0	0	0	1	14	
8:00 AM	0	0	2	0	0	0	0	0	0	0	4	1	0	0	0	0	7	0
8:15	0	0	3	0	0	0	0	0	0	0	3	0	0	0	0	0	6	0
8:30	0	0	4	0	0	0	0	0	0	0	5	1	0	0	0	0	10	0
8:45	0	1	3	0	0	0	0	0	0	0	4	0	0	1	0	0	9	0
HR TOTAL	0	1	12	0	0	0	0	0	0	0	16	2	0	1	0	0	32	
9:00 AM	0	0	2	0	0	0	0	0	0	0	3	0	0	0	0	0	5	0
9:15	0	0	2	0	0	0	0	0	0	0	2	2	0	0	0	2	8	0
9:30	0	0	4	0	0	0	0	0	0	0	3	2	0	1	0	0	10	0
9:45	0	0	3	0	0	0	0	0	0	0	2	1	0	2	0	0	8	0
HR TOTAL	0	0	11	0	0	0	0	0	0	0	10	5	0	3	0	2	31	
10:00 AM	0	1	4	0	0	0	0	0	0	0	1	0	0	0	0	0	6	0
10:15	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	4	0
10:30	0	1	3	0	0	0	0	0	0	0	6	2	0	1	0	0	13	0
10:45	0	0	3	0	0	0	0	0	0	0	6	1	0	2	0	1	13	0
HR TOTAL	0	2	12	0	0	0	0	0	0	0	15	3	0	3	0	1	36	
11:00 AM	0	0	5	0	0	0	0	0	0	0	0	1	0	2	0	0	8	0
11:15	0	0	1	0	0	0	0	0	0	0	3	1	0	1	0	0	6	0
11:30	0	0	2	0	0	0	0	0	0	0	1	0	0	1	0	0	4	0
11:45	0	0	2	0	0	0	0	0	0	0	4	2	0	2	0	0	10	0
HR TOTAL	0	0	10	0	0	0	0	0	0	0	8	4	0	6	0	0	26	
12:00 PM	0	0	5	0	0	0	0	0	0	0	3	0	0	0	0	0	8	0
12:15	0	0	8	0	0	0	0	0	0	0	2	1	0	0	0	0	11	0
12:30	0	0	4	0	0	0	0	0	0	0	1	1	0	0	0	1	7	0
12:45	0	0	1	0	0	0	0	0	0	0	3	1	0	3	0	0	8	0
HR TOTAL	0	0	18	0	0	0	0	0	0	0	9	3	0	3	0	1	34	0
1:00 PM	0	0	2	0	0	0	0	0	0	0	3	0	0	0	0	0	5	0
1:15	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	4	0
1:30	0	0	2	0	0	0	0	0	0	0	5	3	0	1	0	1	12	0
1:45	0	1	2	0	0	0	0	0	0	0	10	1	0	1	0	0	15	0
HR TOTAL	0	1	7	0	0	0	0	0	0	0	21	4	0	2	0	1	36	0
2:00 PM	0	0	9	0	0	0	0	0	0	0	2	0	0	2	0	0	13	0
2:15	0	0	3	0	0	0	0	0	1	0	3	3	0	0	0	0	9	0
2:30	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0
2:45	0	0	4	0	0	0	0	0	0	0	1	1	0	0	0	0	6	0
HR TOTAL	0	0	16	0	0	0	0	0	0	0	6	4	0	4	0	0	30	0

Site Code : ACTDA
N-S Street: MAIN ST.(ROUTE 27)
E-W Street: HAYWARD ROAD,ACTON,MA.
Weather : PT.CLOUDY,WARM

Movements by Secondary

DATE: 5/05/98

Time Begin	From North PEDS	RT	THRU	LT	From East PEDS	RT	THRU	LT	From South PEDS	RT	THRU	LT	From West PEDS	RT	THRU	LT	Vehicle Total	PEDS Tota
3:00 PM	0	0	4	0	0	0	0	0	0	0	3	1	0	0	0	0	8	0
3:15	0	2	4	0	0	0	0	0	0	3	3	2	0	1	0	0	12	0
3:30	0	1	3	0	0	0	0	0	0	0	1	2	0	0	0	1	10	0
3:45	0	0	0	0	0	0	0	0	0	0	2	1	0	3	0	0	6	0
HR TOTAL	0	3	11	0	0	0	0	0	0	3	9	6	0	4	0	1	36	
4:00 PM	0	0	2	0	0	0	0	0	0	0	4	1	0	2	0	0	9	0
4:15	0	1	2	0	0	0	0	0	0	0	0	0	0	1	0	1	5	0
4:30	0	0	4	0	0	0	0	0	0	0	2	2	0	0	0	0	8	0
4:45	0	0	2	0	0	0	0	0	0	0	1	0	0	1	0	0	4	0
HR TOTAL	0	1	10	0	0	0	0	0	0	0	7	3	0	4	0	1	26	
5:00 PM	0	0	1	0	0	0	0	0	0	0	1	1	0	1	0	1	5	0
5:15	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0
5:30	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0
5:45	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0
HR TOTAL	0	0	4	0	0	0	0	0	0	0	2	2	0	2	0	1	11	
6:00 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
6:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Break																		
6:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
HR TOTAL	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	3	
DAY TOTAL	0	8	118	0	0	0	0	0	0	0	110	38	0	32	0	11	317	0

Site Code : ACTOWN
N-S Street: MAIN ST.(ROUTE 27)
E-W Street: HAYWARD ROAD,ACTON,MA.
Weather : PT.CLOUDY,WARM

Movements by: Secondary

Phase: 2
FILE: ACTOWN7
DATE: 6/05/96

PEAK PERIOD ANALYSIS FOR THE PERIOD: 7:00 AM - 7:60 PM

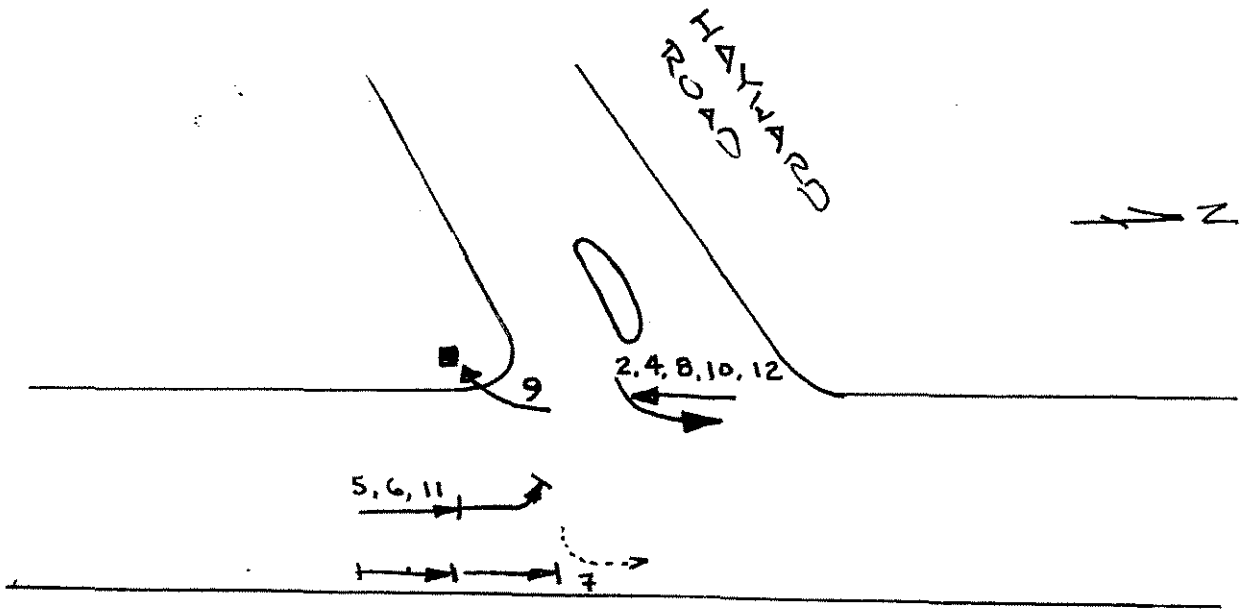
DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES PEDS	Right	Thru	Left	Total	PERCENTS PEDS	Right	Thru	Left
North	2:45 PM	0.83	0	3	17	0	20	-	15	85	0
East	2:45 PM	0.00	0	0	0	0	0	-	0	0	0
South	1:30 PM	0.61	0	0	20	7	27	-	0	74	26
West	3:30 PM	0.67	0	6	0	1	8	-	75	0	25
Entire Intersection											
North	1:30 PM	0.47	0	1	16	0	17	-	6	94	0
East		0.00	0	0	0	0	0	-	0	0	0
South		0.61	0	0	20	7	27	-	0	74	26
West		0.67	0	6	0	1	8	-	75	0	25

Vanasse Hangen Brustlin, Inc.
Engineers, Planners, and Scientists
101 Walnut Street, P.O. Box 9151
Watertown, MA 02272
617 924 1770 • FAX 617 924 2286

COLLISION DIAGRAM

PROJECT WARRANT STUDY LOCATION MAIN | HAYWARD, ACTON MA

JOB NO. 04994 DATE JAN., 1993 - MAY, 1996 BY ACC. REPORTS | ACTON P.D.



MAIN ST. (RTE 27)

DIAGRAM NOT AVAILABLE: 1, 3*, 13, 14

* PEDESTRIAN ACCIDENT

SYMBOLS

ANGLE	PEDESTRIAN	FATAL ACCIDENT	●
BACKING	REAR END	INJURY ACCIDENT	○
FIXED OBJECT	SIDE SWIPE	VEHICLE	→
HEAD ON	TURNING MOVE	PEDESTRIAN	—○
OUT OF CONTROL	CHANGE LANE	PERSONS KILLED	K
		PERSONS INJURED	I

LIGHT CONDITIONS

1. DAYLIGHT
2. DAWN OR DUSK
3. DARKNESS
4. UNKNOWN

ROAD CONDITIONS

1. DRY
2. WET
3. SNOW OR ICY
4. OTHER

VIOLATIONS

0. NO VIOLATIONS
1. SPEED TOO FAST
2. FAILURE TO YIELD
3. RAN STOP SIGN
4. RAN TRAFFIC SIGNAL
5. FOLLOWING TOO CLOSE
6. IMPROPER PASSING
7. WRONG SIDE OF ROAD
8. IMPROPER TURNING
9. IMPROPER BACKING
10. HAD BEEN DRINKING
11. PEDESTRIAN VIOLATION
12. RECKLESS DRIVING
13. IMPROPER LIGHT OR BRAKES

DATE	TIME	P.D.	K	I	L	R	V		DATE	TIME	P.D.	K	I	L	R	V
1|12|93	9:23AM	✓	-	-	1	3	-	11	10|3|95	5:59 PM	✓	-	-	1	1	-
8|13|93	5:27 PM	✓	-	1	1	1	-	12	1|12|96	4:11 PM	✓	-	-	1	3	-
11|1|93	7:30 PM	✓	-	1	3	2	-	13	3|2|96	10:12AM	✓	-	-	1	3	-
7|27|94	5:42PM	✓	-	-	1	1	-	14	5|21|96	1:04PM	✓	-	1	1	1	-
10|27|94	1:38PM	✓	-	-	1	1	-	15								
1|5|95	5:45PM	✓	-	-	3	1	-	16								
5|15|95	7:20 AM	✓	-	-	1	2	-	17								
5|19|95	5:40PM	✓	-	-	1	1	-	18								
6|21|95	9:58PM	✓	-	-	3	1	10	19								
9|23|95	12:48PM	✓	-	1	1	1		20								

[redacted]
Vanasse Hangen Brustlin, Inc.

Transportation
Land Development
Environmental Services

VHB

101 Walnut Street
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FAX 617 924 2286

Memorandum

To: Mr. David Abbt
Engineering Administrator
Acton Engineering Department
Town Hall 472 Main Street
Acton MA 01720

Date: February 4, 1997

Project No.: 04994

From: John J. Kennedy, P.E.

Re: Main Street at Hayward Street

An initial analysis of traffic operations within the subject intersection has been completed and several alternatives for improvements, all based on the installation of traffic signals, have been developed. This initial phase of a follow-up study to a Signal Warrant review conducted for the intersection is intended to provide the Town with data on improvement alternatives and costs.

The result of the signal warrant analysis was reported in a Memo dated June 20, 1996. Volumes approaching the intersection were of level which warranted signalization. Note that the warranting volumes could have been reduced based on intersection accident experience (14 over 40 months) and were close to eligible for reduction based on measured approach speeds. However, counted volumes exceeded warranting volumes without the application of the reduction factors. Given these findings, the Town decided to proceed to this level of review.

The addition of traffic signals at an intersection generally degrades the capacity of and operating conditions within the intersection area. The primary function of signals are to create order within the intersection. Consequently, in many instances, the introduction of signal control to a two lane roadway such as Main Street at an intersection like Hayward Road will lead to the addition of one or more turn lanes. Other constraints which must be recognized include turning movements to and from the various legs of the intersection, and the types of vehicles which frequent the intersection. The constraints associated with this become more pronounced when the intersection is skewed, such as the Hayward Street approach.

The traffic volumes measured within the intersection area are expected to grow over the design life of signal control. In a standard Massachusetts Highway Department (MHD) funded project, design volumes are developed to a ten year design condition. We feel that a growth rate of two (2%) percent per year is appropriate within the area for the afternoon peak hour condition. This would result in the use of design volumes approximately 20% higher than those counted in June, 1996. If MHD funds were not sought for improvements, development of design hour conditions would still be recommended as part of the process of developing intersection improvements.

When analyzing signal operation, a Level of Service is defined for the movement of vehicles through the intersection. Levels are based on average vehicle delay for the intersection as a whole and also by

individual approach and movement from the individual approach. During peak hours, an overall Level of Service C is desirable with Level D acceptable. These equate to average vehicle delay ranges of 15 to 25 seconds and 25 to 40 seconds, respectively. Individual approaches should not exceed Level D with individual movements, such as a minor left turn, not exceeding Level E (40 to 60 seconds). In addition to Level of Service, vehicle queuing must also be recognized. As traffic volumes increase on single lane approaches, the extent of back-ups increase. These can be viewed as excessive and impact other intersecting roadways even if Level C or D conditions are maintained within the controlled intersection. These back-ups may also cut-off access to special purpose lanes (right or left turn only lanes), further reducing the carrying capacity of the intersection. It should be noted that queuing calculations by traffic models now in use are generally conservative. Two levels of queuing are defined. The average queue is one which could be expected at any time during the hour under review. The 95th% queue, or design queue, is one which would be exceeded only 5% of the time.

With these constraints understood, a series of analyses were completed for the intersection. Initial analysis led to the identification of the need for a left turn lane northbound on Main Street with one lane to be available to northbound through traffic. The lane is viewed as necessary for two reasons. Initially, it provides an area in which left turns can wait for gaps in the southbound flow without impacting the through movement. Secondly, it allows the opportunity to provide an effective protected green interval in which left turns may be completed without conflict from southbound movement.

Given these conditions, a series of plans have been developed. All include the creation of the northbound left turn lane and modification of the northwest corner radius to allow WB50 design vehicles to turn from Hayward Road on Main Street southbound and stay within the departure lane. This change in the corner radius is associated with a shift in the centerline of Main Street because of the introduction of the left turn lane. Each also includes widening on the northbound approach to allow creation of the left turn lane. The resultant 38 foot wide roadway allows six feet on both sides between the travelway and the right-of-way. The following provides a summary of each. Plans illustrating Options 1, 2 and 3 are attached.

- Option 1, the "Minimum Build" Option, includes construction associated with the provision of a left turn lane on Main Street northbound, modification of the southwest corner radius to allow WB50 movement from Hayward Road to Main Street southbound and signal installation. Modification of the existing Hayward Road center island is also proposed. Based on existing traffic demand, this option provides an overall Level of Service D, with Hayward Road at Level E. During the design year, Level D is maintained, again with Level E on Hayward Road. The basic difference between the existing condition in the increase in overall delay and the extent of back-ups, most notably on the Main Street southbound approach. The average queue under existing conditions is 800 feet (32 vehicles) and close to 1000 feet (40 vehicles) during the design year. Design level queues are estimated at 1150 feet under existing conditions and in excess of 1300 feet during the design year. As a note, Musket Drive is only 300 feet from the intersection and would be subject to regular blockage by the southbound queue. Land taking required with this option would be limited to the northwest corner parcel. Sidewalk easements along both sides of Main Street may be desirable however given the proposed widening of Main Street to 38 feet. This allows room for a six-foot sidewalk or buffer to the right-of-way on both side of the corridor.

- Option 2 involves all aspects of the Minimum Build option with the development of a second approach lane on Hayward Road. The two lane approach would be needed within 150 feet of the intersection. With this Option in place, intersection operation would be at Level C , with all approaches at Level D or better in the design year. The second lane on Hayward requires an additional taking from the parcel on the northwest corner along the Hayward Road frontage and further expansion of the taking along the northwest corner radius area. The second lane on Hayward Road allows a lower proportion of green time to be assigned to that approach resulting

in the better level of service. Southbound queuing will however continue to be a problem with access to the right turn lane restricted and blockages of Musket Drive common during peaks. The average design year back-up was found to extend 750 feet from the intersection (versus 1000 feet in Option 1), equivalent to 30 vehicles.

- Option 3 involves the design conditions associated Options 1 and 2. It is geared to reducing the southbound queue on Main Street. By extending the existing right turn lane from Main Street to Hayward Road farther to the north beyond Musket Drive, the actual volume which would be handled in the single through lane may be reduced. With access to the lane limited to a point approximately 100 feet from the intersection, less than 100 of the 275 vehicles desiring to turn right can get to the lane when signals are red. Lengthening the lane to over 300 feet will allow a higher percentage of right turning vehicles to reach the lane on red, serving to reduce the overall southbound queue length. Level of Service B operation is attained during the design year, with an overall delay slightly less than that with Option 2. No approach is worse than Level C. The average queue length southbound is reduced to 575 feet (23 vehicles), still impacting Musket Drive during the peaks. Note that this back-up may be further reduced by allowing the Hayward Road approach to operate at a Level of Service D. A land taking would be required together with the removal of several large trees to effect this option.

- Option 4 involves considerable widening through the corridor. It was developed to define the necessary level of improvements in order not to queue vehicles across Musket Drive. Essentially the option develops two southbound lanes for through traffic. It would extend from slightly north of Musket Drive (approximately 100 feet) to a point approximately 400 feet south of Hayward Road. Tapers from the two lane sections would extend an additional 250 to 300 feet north and south of these limits. Operation would be at Level B with southbound queues averaging less than 150 feet with a design level queue of less than 250 feet, all south of Musket Drive. This widening has a significant impact on west side properties requiring 12 to 15 foot wide taking over much of the widened length. A local example of the resulting intersection layout and operation would be the Route 2A corridor at Main Street. Plans have not been prepared for this alternative given the magnitude of the widening beyond currently available base plans.

Construction costs associated with the first three options have been estimated initially based upon Massachusetts Highway Department funded improvements. Option 1 is estimated at $240,000. The widening of Hayward Street, together with a slightly expanded resurfacing area, is estimated at $35,000., resulting in an Option 2 cost of $275,000. The extension of the Main Street southbound right turn lane to Musket Drive is estimated at $15,000., resulting in a total Option 3 cost of $290,000. Should MHD funds not be used for improvements, cost reduction would be anticipated. Dependent on materials used, Town forces participation in construction, etc., these estimated costs could be reduced by 25% or more. Note that the estimates do not include costs associated with land acquisition.

Design costs including construction related services associated with signal equipment approval and testing/acceptance are estimated at $18,000 for any of the three options under the MHD funding option. Should Town funds be used for implementation, the design costs would be reduced by approximately 20% to $14,000 to $15,000. These costs assume that additional survey information for the area will be furnished by the Town that land acquisition documents will be prepared by the Town and that full time construction inspection/administration will be provided by others.